

MANAGEMENT INFORMATION SERVICE

INTERNATIONAL CITY MANAGERS' ASSOCIATION
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PLANNING FOR SNOW AND ICE CONTROL

What is the plan of organization for snow and ice control? How should a city approach such special problems as removing snow from sidewalks and driveways?

This report outlines the planning and organization for municipal snow and ice control and describes some operational problems based on the experience and practice of 133 cities in the United States and Canada. Much of this report is based on a survey made in the winter of 1949-50 by the American Public Works Association. At that time the APWA polled 120 cities on their snow removal practices. Thirty-one of these cities were over 200,000 population, and the remaining 89 cities were under 200,000. To supplement this study, additional data were secured directly by MIS in June, 1951 from 13 snowbelt cities from 5,000 to 200,000 population.

Council Authorizations

The city administration needs two decisions from the city council before planning for snow removal can start. First, the city should have an ordinance authorizing the police department to restrict parking on certain streets and to remove cars from streets to permit snow plowing and loading. Second, the city council in adopting the annual appropriation ordinance must decide the extent of snow removal service to be provided. Some streets require both plowing and snow removal, some require only plowing, and others may not be touched at all. In the largest cities like Detroit, Chicago, and New York, it is impossible to plow more than a small percentage of the total street mileage.

Advance Planning

One city employee should be designated as the head of all snow removal work. The logical person for this job is usually the head of the street cleaning organization for the city. It is his job to draw up snow fighting plans well in advance of the winter season and to take charge when necessary of all snow removal and ice control work. At least five specific steps should be taken by the street superintendent in planning snow removal work for the winter season.

Routes and Schedules. The street superintendent should lay out routes and adopt schedules for pavement plowing, snow removal, sidewalk plowing, crosswalk plowing, and ice control. It is often convenient to divide the city into districts with a crew assigned to each district. Then the priority order for specific streets in each district can be designated. A list of streets should be prepared for each crew foreman showing the work that is to be done on each street and the order in which streets are to be cleared. It may be easier to duplicate portions of city maps for each foreman showing by colored pencil the work to be done on each street.

(Over)

Organization of Crews. Snow removal crews must be established, including foremen, equipment operators, and laborers. Usually the men can be recruited from the street cleaning unit and other public works units in the city government, including street maintenance men and refuse collection crews. These forces can be supplemented in some cities by temporary and casual laborers. In these times of labor shortage, however, primary reliance must be placed on city employees, and experienced men always should be used as foremen and equipment operators.

Two or three shifts of men are desirable for snow removal work, especially in cities that can regularly expect severe storms. A number of cities have stated that single shifts of 24 to 36 hours waste manpower. These cities prepare the snow removal plan so that a second shift begins work after the first shift has been on duty about 12 hours.

Renting Equipment. Advance arrangements should be made, if necessary, for renting dump trucks from general contractors and sand and gravel companies. Not all cities have sufficient equipment to handle the snowfall from severe storms. About one-fourth of the cities included in the APWA report contract for private trucks to add to those made available by the city for snow removal work or plowing. Officials in Hartford, Connecticut, feel the practice is fully justified, even though the cash outlay appears high, because snow fighting is rugged work and trucks experience many breakdowns. Having at least a part of the snow-fighting equipment maintained by private contractors relieves the city force and avoids overloading the regular garage maintenance force.

Transit Lines. The chief administrator must make sure that street car and bus lines understand their part of the job in keeping transportation open. In many but not all cities the franchise provides that the transportation company will do a certain amount of snow plowing. The responsibility of the transportation company, if any, must be established in advance of the winter season.

Traffic and Parking Control. The chief administrator should assign definite authority and responsibility to the police department for controlling traffic, restricting parking, and removing and impounding cars that interfere with snow removal work. The street superintendent should furnish the police department the route assignments and schedules for snow plowing and removal.

Snow Plowing and Removal

Weather Forecasts. Advance warning of snowstorms is an absolute requirement for successful snow fighting work. The United States Weather Bureau, in areas where it has stations, is glad to provide city officials with advance information concerning the progress of storms. The weather bureau can phone the city manager or street superintendent if emergency conditions occur suddenly, in addition to providing regular weather reporting service. Some cities consider this advance warning so important that they subscribe to private weather bureau services. The facilities of these private services in some areas are more frequent and detailed than those of the United States Weather Bureau. The annual cost of about \$400 is more than made up by savings in being prepared for any kind of storm. Forecasting may be supplemented by actual observation. Night watchmen, maintenance crews, or cruising policemen may be designated to notify the street superintendent, so that he can decide whether or not the assemble order is to be given.

Preparation for actual operation commonly has three steps: (1) Alert--the preliminary notice to all personnel that a storm is brewing and their services are likely to be required; (2) Assemble--the notice to all employees to report

immediately to their posts and to load equipment and attach plows; (3) Operate--the notice to begin assignments. The telephone fan-out system in which each supervisor and foreman calls six or eight of his subordinates according to a preplan assures that the word is spread quickly and positively to everyone who will be concerned in the snow defense operation.

Work Operations. When a heavy snow is expected plows should be sent out as soon as the fall has reached one inch so that the plowing force can stay ahead of the continuing fall and either clear the streets or windrow the snow before it is compacted by traffic. Early applications of rock salt at the rate of about 500 pounds per mile of 20 foot pavement will keep the snow mealy, prevent its bonding or freezing to the pavement, and provide safe footing for vehicles. Some cities consider it satisfactory to apply chlorides in the vicinity of intersections only, allowing cross and through traffic to spread them effectively.

The treating or plowing schedule should begin in the central business district, fan out to the arterials, and wind up with secondary and residential streets. The extensiveness of operations depends on the money available for snow fighting and the requirements of the community. The most usual pattern among the 120 cities surveyed by the American Public Works Association was that of removing snow in the central business district, plowing primary, secondary, and paved residential streets, and applying abrasives to hills, curves, and intersections which were likely to become dangerous. The average city plowed 102 miles and removed snow from 16 miles.

Snow loaders ordinarily begin working when the snowfall reaches about four inches. By this time abrasive trucks will have completed their work and will be available for hauling snow, and the plows that started several hours earlier will have windrowed the snow so that the removal can proceed effectively.

To shorten hauls of snow removal trucks, some cities dump the snow into large-capacity combined or sanitary sewers. Manholes are enlarged and blocks placed so that trucks will not back into the holes. These sewers, carrying warm sewerage, help melt and carry off the snow. Open streams are also good but frozen streams should be used sparingly; spring thaws may cause flooding if open spaces are used for dumping. A bulldozer should keep the areas leveled so trucks can get in and out without stalling.

Plowing and snow removal require that streets be cleared of parked vehicles. A number of cities have special "No Parking" regulations for such emergencies. Local radio stations frequently will make spot announcements to remind motorists of parking bans and to notify them of the location of plows and removal equipment so they can stay off those streets. Some cities enforce the "No Parking" regulations by towing cars to a central pound where they may be redeemed for the towing charge plus a fine. This practice is not unreasonable when motorists insist on having clear and safe winter streets to travel on.

Radio Communication. One- or two-way radio communication between the dispatcher and plows or circuit riders speeds up assignment of equipment and enables a single dispatcher to coordinate the movements of all vehicles as traffic or weather conditions change. Some cities use retired one-way police radio in key public works vehicles. Others station a radio-equipped police car at the dispatcher's office to follow the progress made by police cruisers and towing equipment in clearing parked vehicles from the plow routes. A few cities use two-way radio in the cars of supervisors. Hartford, Chicago, and Keene, New Hampshire, are among the cities using radio-equipped vehicles.

Equipment. From the standpoint of obsolescence, available storage space, and economy of cash outlay, snow fighting equipment that has other year-round uses is highly desirable. Trucks, tractors with scoop and blade attachments, motor graders, and some types of loaders can serve such dual purposes. Bucket-conveyor loaders which remove snow in the winter can be used during the construction season to load sand, gravel and crushed stone; when not on snow duty in the winter, they can load coal, fill elevated abrasive-storage bins or fill ice control trucks with abrasives from treated stock piles. Elevating loaders have capacities of 200-400 cubic yards per hour. Motor graders are versatile year-round implements. Tractors which in summer are used for mowing or construction work, in winter can clear crosswalks, add to the complement of plows, assist in snow loading, or keep snow dumping areas in condition for easy operation of dump trucks.

Most city construction trucks used for light or heavy hauling should be purchased with snow removal operations in mind since in heavy snowfalls or severe ice conditions all available equipment is likely to be drafted. A minimum capacity of three yards for all trucks used in snow removal work is desirable. Smaller trucks are under-powered, have difficulty negotiating the dump areas, and must be used in larger numbers or make more frequent trips. Three yard capacities may be increased by extending sideboards above the regular truck body. Cities that must do considerable plowing or ice treating on hills may find all-wheel drive trucks profitable. Straight blade plows may be either front-end or under-body attached and where heavy snow conditions warrant, front-end attachments should be interchangeable for straight and V plows.

Trucks with full spreader bodies may not be economical in any but large cities or those with large paving programs. End-gate attachments for standard dump bodies can be obtained in several types. The box type, running the full width of the end-gate, may have year-round applications. The disc type rides on a trailer behind the dump truck. Abrasives are funneled into the spreader when the dump is elevated and are spread for varying distances by a centrifugal disc actuated by the trailer wheel or by a separate gasoline motor. Mechanical spreading is more efficient and economical than hand spreading by laborers standing in a truck. The application is even over the entire area and the amount of material spread can be controlled by the driver to take account of varying road and weather conditions.

Three types of equipment--spreader trucks of large capacity, all-wheel-drive heavy plowing equipment, and rotary snow plows capable of moving 1,000 cubic yards an hour--may be required in areas where snowfall and drifting are heavy or where hills require continuous application of abrasives to keep driving conditions safe. Such equipment, though lacking in year-round versatility, may get heavy winter use that fully justifies its purchase and maintenance.

MIS will furnish to any interested subscriber a list of firms that manufacture both all-purpose and specialized snow-fighting equipment including plows, loaders, spreaders, high speed rotaries, and chlorides for ice control.

Ice Control

Prompt and frequent application of abrasives or chlorides assumes greater importance than plowing or snow removal in certain parts of the snow belt where icy conditions are frequent. In these cities accurate weather forecasting is even more important than in areas of high snowfall, for slick ice is often formed at practically the instant precipitation begins. Spreader trucks or end-gate trailers operating with standard dump trucks make even and economical application of abrasives relatively easy.

Ice control abrasives can be chloride-treated, stock piled indefinitely, and loaded into trucks by bucket elevators or power shovels when needed. It is desirable to store abrasives in elevated bins that can be filled from the top and then load trucks by gravity from underneath. Overhead loading takes less than one-third the time required for hand loading by four men. Decentralized stock piling makes shorter truck hauls. Bins of from 100 to 150 cubic yards capacity are a convenient size, though smaller ones may be used satisfactorily. During the construction season bins are good for storing different sizes of aggregate for surfacing and patching.

Chlorides and Abrasives. Abrasives--sand, cinders, ashes, slag, rock salt, and calcium chlorides--used alone or in combination to prevent skidding have attained wide popularity, apparently because the public insists upon driving under winter conditions at speeds normal for clear roads. Of the 120 cities whose ice control practices were described in the APWA reports, 111 use one or more abrasive materials. Cities in Canada and the northern part of the snow belt use sand, cinders, or a mixture of the two to provide traction on compacted snow. Where relatively mild temperatures or alternate thawing and freezing frequently cause icing, rock salt or calcium chloride used alone or combined with sand or cinders is popular. Distribution of preference for abrasive combinations among the 111 cities is as follows: rock salt with sand or cinders, 34; cinders, 25; sand, 22; calcium chloride with sand or cinders, 15; salt, 9; salt and calcium chloride, 3.

Rock salt melts ice effectively at temperatures down to 0 degrees Fahrenheit, but refreezes at -6 degrees Fahrenheit. Calcium chloride melts effectively down to -50 degrees Fahrenheit and is thus useful through a wider range of temperatures. In addition, calcium chloride melts ice much more quickly, but rock salt is the only material that completely frees the pavement of ice.

When combined with abrasives, the recommended proportion of calcium chloride for stock piles is 100 pounds per cubic yard and another 50 to 100 pounds at time of application to speed the melting action. Use of calcium chloride alone is not recommended by the manufacturer because it is relatively expensive, and only one city--Manitowoc, Wisconsin--reported using it in this way.

The nine cities which reported using rock salt alone consider it more economical than combining it with other abrasives. Sand and cinders are said to clog catch basins, and cinders that remain on bare pavement after snow is gone must be swept from the streets. With salt alone no mixing is required and spring catch basin and street-cleaning expense is held to a minimum. The recommended application of 500 pounds per mile of 20-foot pavement may be varied depending on the temperature and extent of snowfall. Some of the cities salt only intersections and short portions of streets from intersections, allowing through- and cross-traffic to spread the salt effectively for greater distances. If temperatures do not fall below 0 degrees Fahrenheit, salt will keep the snow mealy so that it is easily plowed and picked up for removal, will prevent icing, and keep drains open for quick runoff when temperatures go above freezing.

Special Snow Removal and Ice Control Problems

In any snow removal program the city is certain to be asked to provide special services to schools, churches, retail merchants, and other property owners. These services include plowing residential sidewalks, controlling snow removal from filling stations and parking lots, clearing residential driveways, and removing snow from churches, schools, auditoriums, and theaters. These services are quite expensive and it is a matter of city policy as to whether they should be provided.

Should the city clear residential sidewalks? The American Public Works Association reports showed that 26 out of 30 cities over 200,000 population do not clear residential sidewalks; three, Kansas City (Missouri), Montreal, and Winnipeg, plow all residential sidewalks; while Milwaukee provides for plowing at the expense of the property owner. Twenty of the reporting cities under 200,000 population plow 50 per cent or more of the residential sidewalks, but none of the remaining 69 cities plow more than 25 per cent of the sidewalks. The 20 cities that reported plowing 50 per cent or more of the residential sidewalks are Evanston, Illinois; Bangor, Maine; Methuen, Watertown, and Weymouth, Massachusetts; Lansing, Michigan; St. Cloud, Minnesota; Rome, New York; Wausau and Wauwatosa, Wisconsin; Edmonton, Guelph, Moncton, Sherbrooke, Regina, Calgary, St. John, Trois Rivieres, Port Arthur, and Ottawa, Canada.

What rules should cover snow removal from filling stations and parking lots? The survey of 13 cities by the International City Managers' Association shows that eight of these cities prohibit parking lot and filling station operators from clearing snow into the streets. Four cities allow the snow to be pushed into the streets for removal by the city as part of regular snow removal service--Dubuque, Iowa; Niagara Falls, New York; Grand Forks, North Dakota; and Ashland, Wisconsin. Ashland, however, charges a special fee of 25 cents per front foot for this service. Escanaba, Michigan, reported that no set policy has been established on this question.

Is the city obligated to clear residential driveways after plows have filled the driveways with snow from the streets? Among the 13 cities surveyed by ICMA only Ashland, Wisconsin, and Verdun, Quebec, provide special crews to clear residential driveways after streets have been plowed. Ashland does so only after extremely heavy snowfalls.

Should the city provide snow removal service for churches, schools, auditoriums, and theaters? None of the 13 cities surveyed by ICMA give special snow removal service to theaters and auditoriums except Bangor, Maine, which clears the parking area for its municipal auditorium. Likewise, none of the cities except Ashland, Wisconsin, clear snow from parking areas around schools and churches. The city manager of Ashland estimated the cost of snow removal for filling stations, parking lots, churches and schools at \$7,000 per year and the revenue from the special charge for filling stations and parking lots is \$3,300 per year.

Pavement Scaling. Do chlorides cause scaling of concrete pavements? There are firm believers on both sides of this question, but positive proof has not yet been offered by either side. It is true that some concrete pavements tend to scale but how much is due to normal weathering and how much to the use of salts is not clear. Concentrated chlorides allowed to stand on new pavements do have some harmful effect.

The Portland Cement Association may have the best answer. It attributes scaling neither wholly to weather nor entirely to salt but to the type of cement used. The Association concluded from extensive tests in 1946 and 1948 that air entrainment reduces the incidence of scaling from whatever cause. Other experiments indicate that a long period of curing, of about four years, is desirable when normal Portland cement is used for paving. If this amount of time is not available, short stretches of pavement such as bridges may be treated with applications of linseed oil and turpentine or other material to seal the surface and prevent penetration of the chloride brine.

Metal Corrosion. The experts also disagree on the effect of calcium chloride and rock salt as an agent in corroding automobile underbodies. Some research groups have stated on the basis of limited tests that atmospheric humidity is a more important factor in corrosion than salt treatment of roads.

Financial Records

Cost of snow work is generally predictable only as an average, and yearly fluctuations around the average may be considerable. Careful year by year weather and expenditure records, however, help in forecasting and making budget estimates. This means that as intelligent a guess as possible should be made of the expected cost of snow and ice control, that the contingent fund should carry an additional amount to supplement the regular snow appropriation if the winter is extremely severe, and that the surplus should be returned to the general fund if the winter is mild and expenses consequently low. The appropriation for snow and ice control should be used only for that purpose and the contingent fund should be drawn upon only in the event the conditions encountered exceed those predicted.

A city should keep these records for annual comparison of snow control costs: (1) depth of each snowfall and total fall for the year; (2) dates and duration of each snowfall and of icy conditions; (3) equipment, supplies and employee cost records; (4) cubic yards or tons of abrasives used; (5) cubic yards of snow hauled and mileage, if distances are appreciable; and (6) total miles of streets cleared and/or treated.

From the foregoing records city officials can calculate unit costs per inch of snowfall, per cubic yard of snow hauled, and per mile of street plowed. Employee time sheets and daily individual motor equipment records and monthly summaries will support the cumulative record of snow removal operations to show miles run and cost per mile and hours run and cost per hour.

Up to the present time little uniformity has been achieved in the matter of record keeping and it is difficult to make inter-city cost comparisons. If a city maintains records like those suggested above, however, it should be able to derive costs of its own over a period of several seasons that will show trends and make annual comparisons possible. Units of measurement for snow control are cost per inch of snowfall, per cubic yard of snow hauled, (per ton-mile if distances traveled are significant), and mile of street cleared. Cost of ice removal may be measured in terms of cubic yards of abrasives used, miles of streets treated, or ton-miles. A form can be prepared for each winter season to show snow removal operations and costs for each snow storm. At the end of the season the form would be a cumulative and chronological record. Such a form could have the following column heads from left to right:

Dates Worked for Each Storm
Snow Fall in Inches
Total Cost of Plowing, Removal and Sanding
Cost per Inch of Fall
Hauling Snow
 Total Hauling Cost
 Total Cubic Yards Hauled
 Cost per Cubic Yard
Plowing Streets
 Total Cost
 Total Clearing Miles
 Cost per Clearing Mile
Kind of Storm and Temperatures

(Over)

Note: Grateful acknowledgment is made to the American Public Works Association (1313 East 60 Street, Chicago 37) for permission to use material from three of their reports. Statistical data on snow removal practices have been taken from "Snow and Ice Control in Cities over 200,000 Population" (1949, 17pp., \$1) and from "Snow Removal Practices in Cities under 200,000 Population and Snow and Ice Control" (1950, 66pp., \$2). The discussion on advance planning for snow removal is based largely on the APWA's "Municipal Snow Removal and the Treatment of Icy Pavements" (1938, 54pp., \$1). The latter book is an excellent presentation of the organization, planning, and operating methods for snow and ice control.

The International City Managers' Association secured information in July, 1951, on the practices of 13 cities in removing snow from filling stations and parking lots, clearing residential driveways, and removing snow for churches, schools, auditoriums, and theaters. The 13 cities that supplied information are Des Moines and Dubuque, Iowa; Bangor, Maine; Escanaba, Grand Rapids, and Muskegon, Michigan; Albert Lea, Minnesota; St. John, New Brunswick; Niagara Falls, New York; Grand Forks, North Dakota; Verdun, Quebec; and Ashland and Eau Claire, Wisconsin.

The form for snow removal operations and costs described on page 559 of this report is shown on page 221 of Donald C. Stone's "The Management of Municipal Public Works" (Chicago: Public Administration Service, 1939. Out of print).